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Hein

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[54] **TRACTION DRIVE ELEVATOR**

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[51] **Int. Cl.**[6] **B66B 11/08**

[52] **U.S. Cl.** **187/254**; 187/270; 187/410

[58] **Field of Search** 187/254, 256, 187/258, 249, 270, 404, 410, 414

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,924,710	12/1975	Shohet	187/270
5,490,579	2/1996	Ratcliffe et al.	187/254

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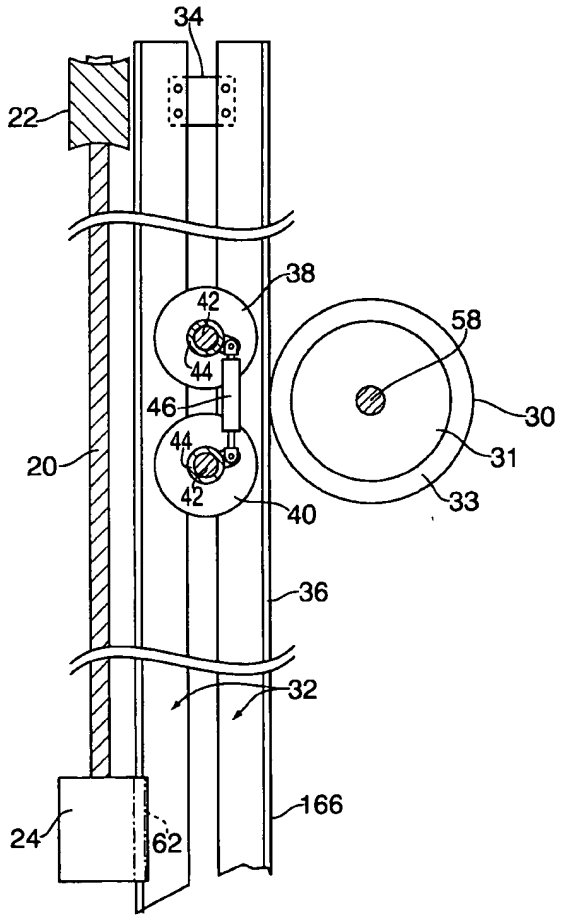
Attorney, Agent, or Firm—White & Case L.L.P.

[57] **ABSTRACT**

A traction drive elevator system preferably comprises a pair of vertical tracks, a car, and at least one counterweight for supporting at least a portion of the weight of the car. A traction drive, which preferably includes a frame which is separate from the car, comprises two sets of drives, each including a large traction roller and a pair of smaller diameter counter rollers which are disposed on opposite sides of one of the tracks. The axis of the traction roller is horizontal preferably at a height midway between the axes of the counter rollers, and the counter rollers are moveable in a direction toward the track. Means, preferably an eccentric mounting in combination with a gas spring, urge the counter rollers towards the track, thereby creating friction between the rollers and the track. A motor and gear box, which preferably includes a worm and spur gear combination, selectively rotate the traction rollers for moving the car between landings. Finally, a safety bar maintains traction between the wheels and the track in the event the gas spring fails. Preferably, the tracks constitute one of two inwardly projecting tracks of a rail which is U-shape in cross-section. The counter rollers are located in the U-shaped trough, and the traction roller is located to the outside of the rail and therefore can be made of substantially larger diameter. The other track is used to guide the counterweight.

11 Claims, 6 Drawing Sheets



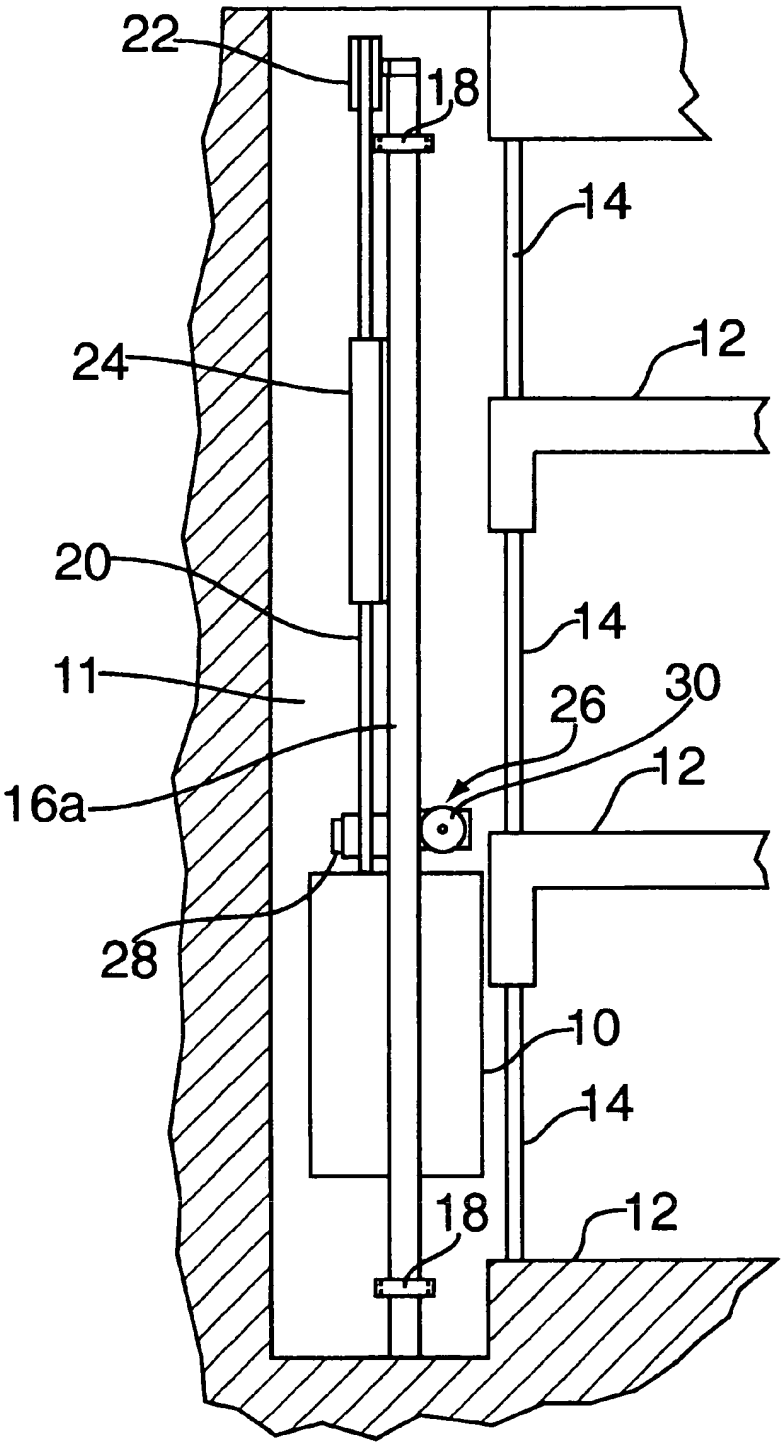
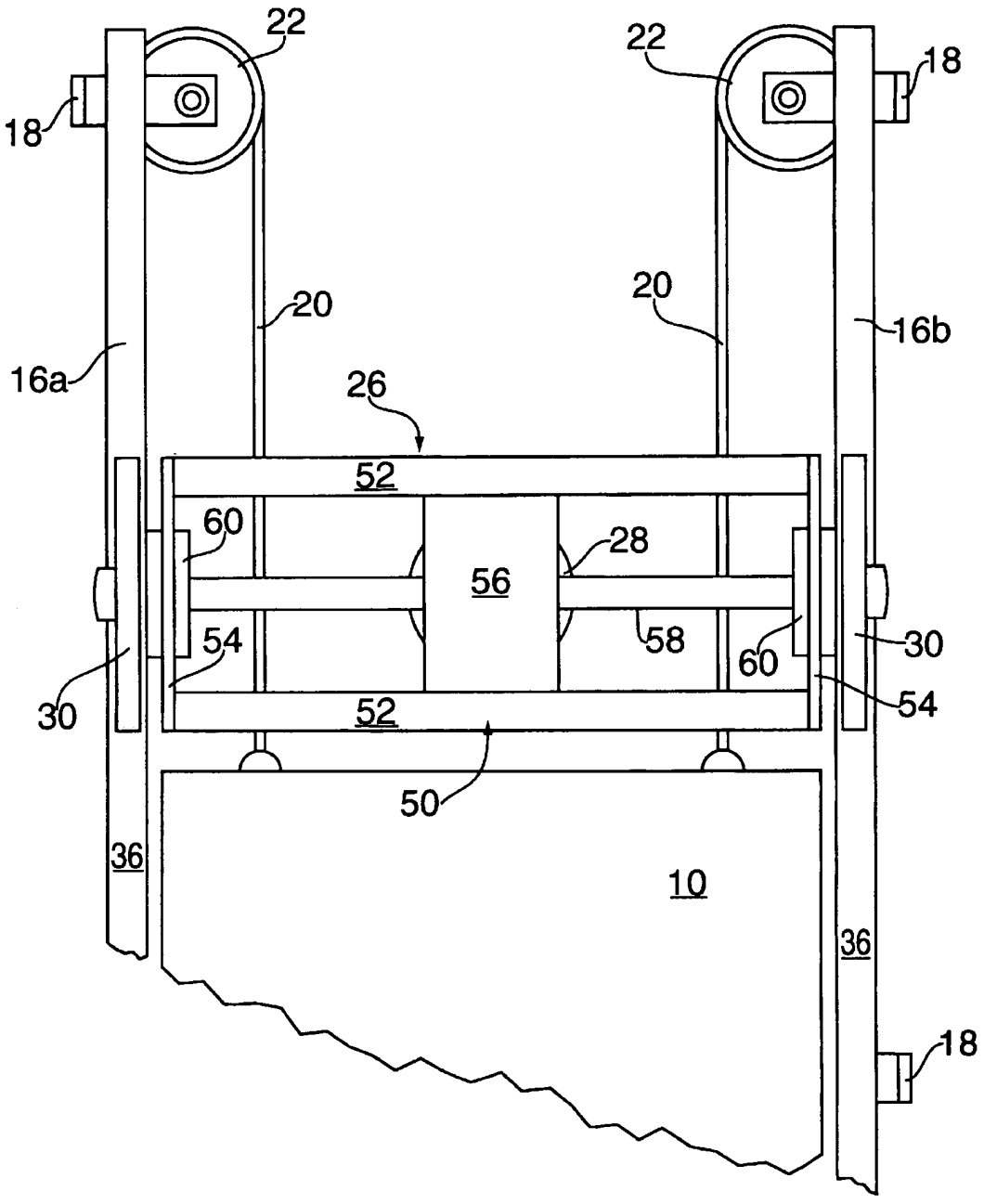


FIG. 1


22
22
18
18
20
20
16b
16a
26
52
60
28
56
54
58
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30
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52
50
36
10
36
18

FIG. 2

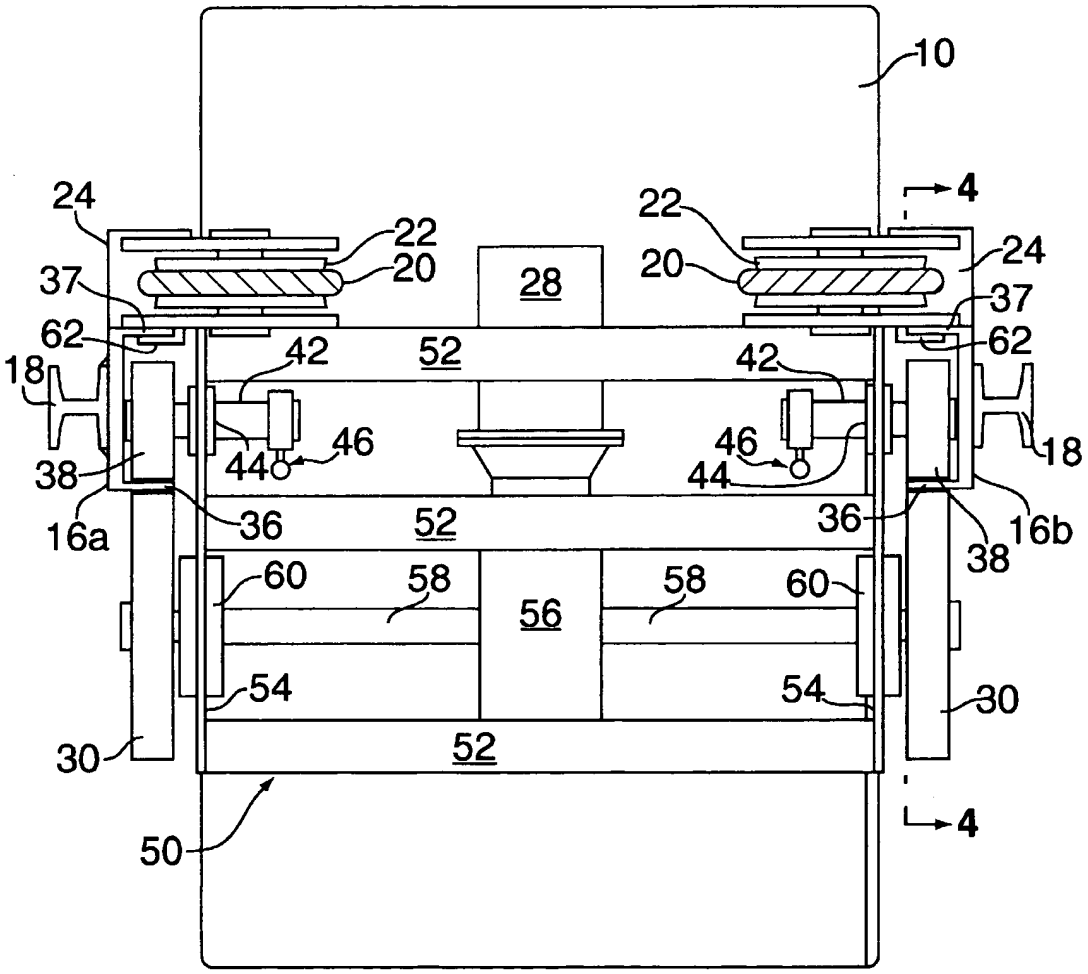

FIG. 3

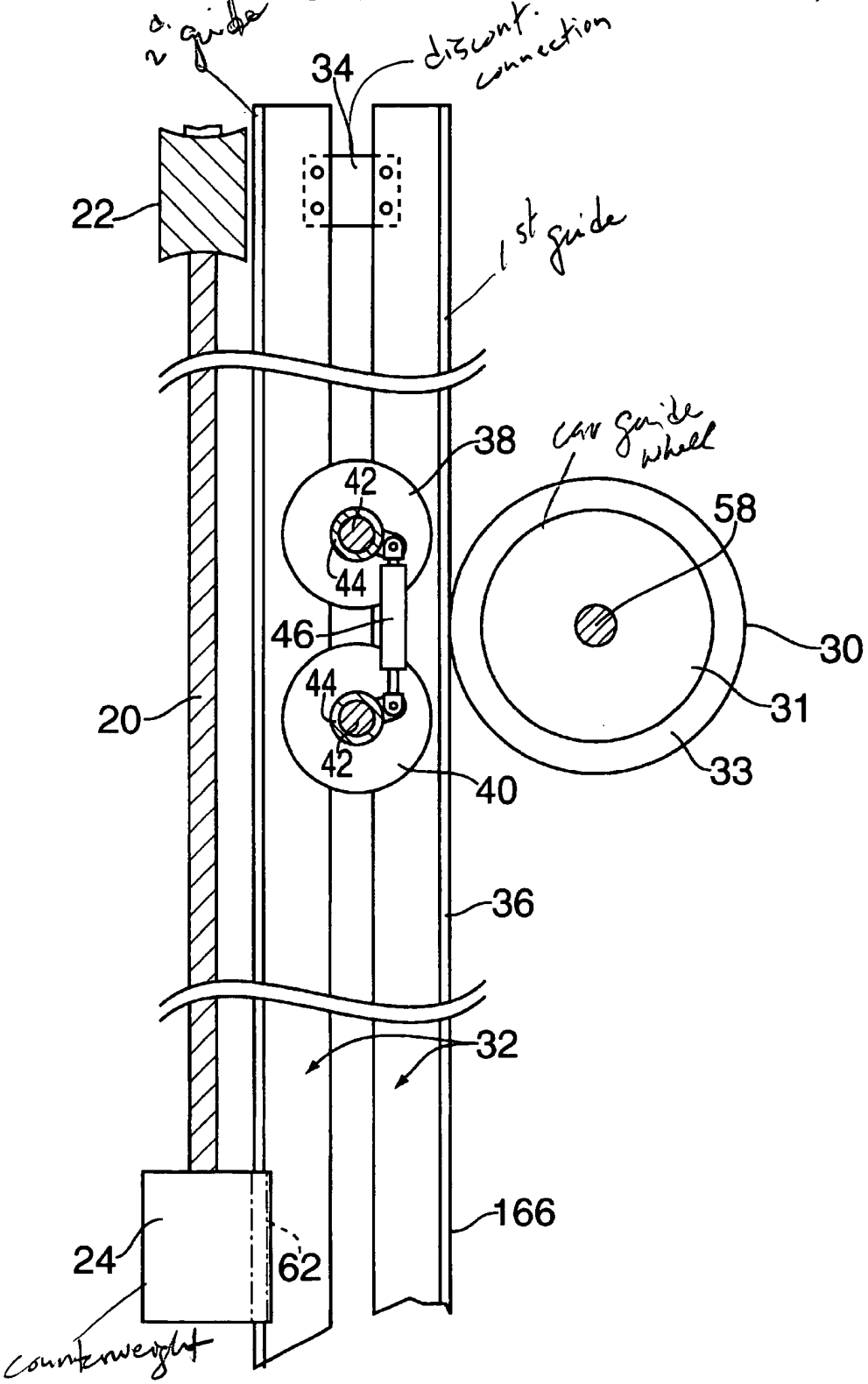
2nd guide
34
disconnect connection
22
1st guide
38
car guide wheel
42
58
44
46
30
44
20
31
42
33
40
36
32
166
24
62
counterweight

FIG. 4

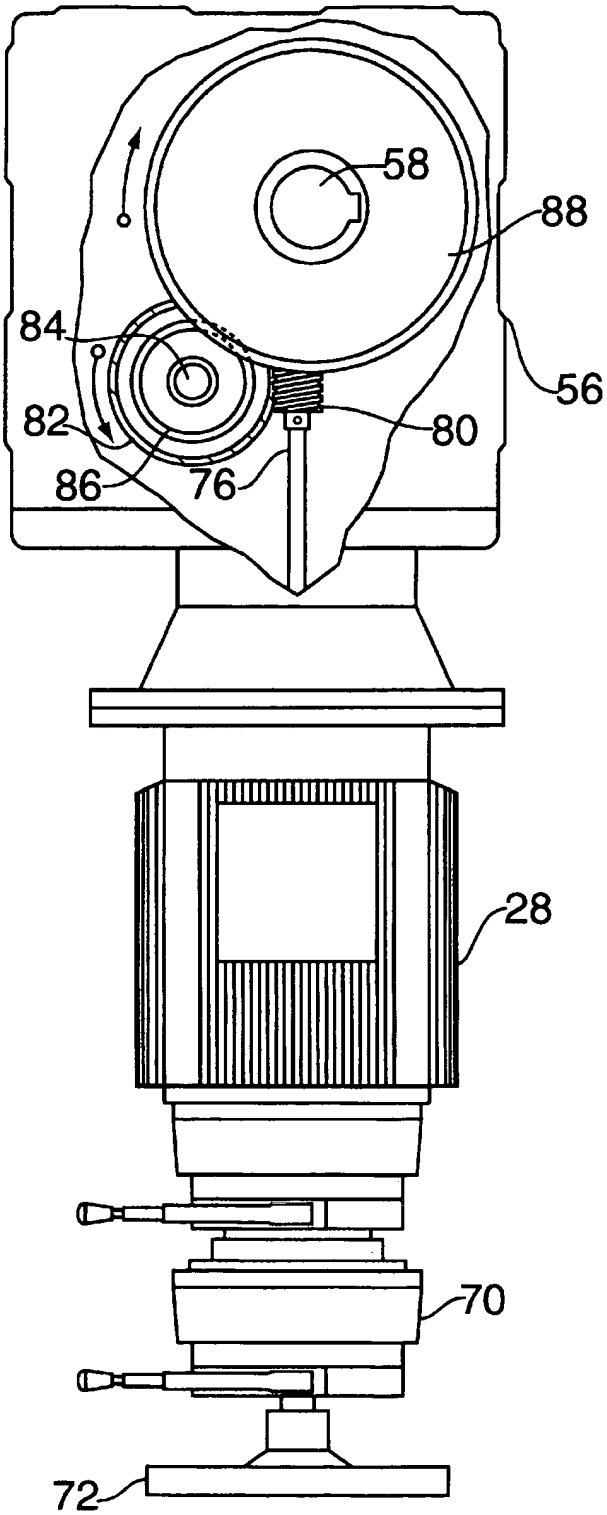

FIG. 5

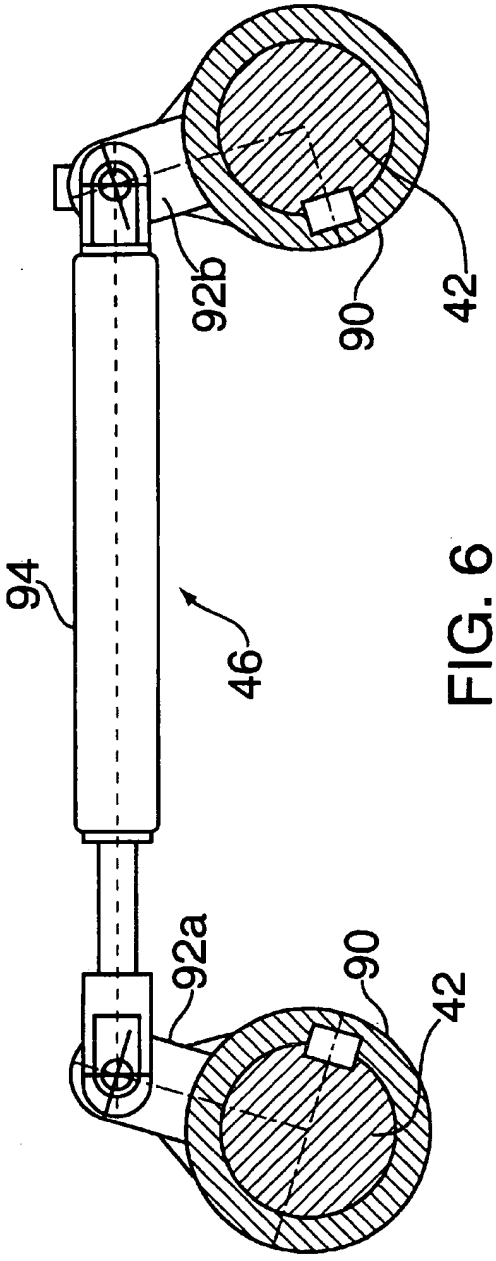

FIG. 6

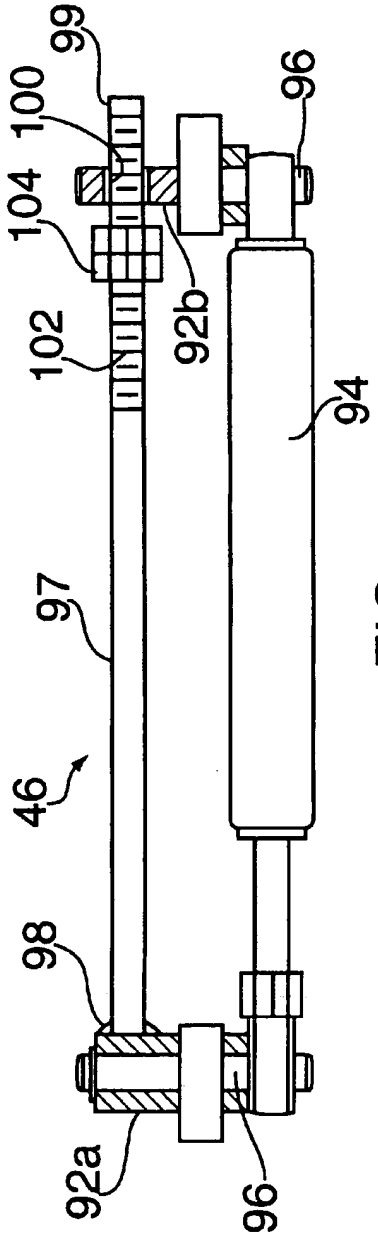

FIG. 7

TRACTION DRIVE ELEVATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to elevators, such as passenger and freight elevators, that operate between two or more floors or landings.

2. Description of Related Art

There are two types of modern elevators, traction elevators and hydraulic elevators. In traction-type elevators, an elevator car is suspended by a wire rope, usually in a hoistway. The rope extends upwardly to the top of the elevator shaft, is directed around an overhead drive pulley, passes over a guide pulley, and thereafter extends downwardly to a counterweight. A motor is coupled to the drive pulley, either directly (a so-called "gearless elevator") or through intermediate gears (a so-called "geared elevator"), such that actuation of the motor selectively raises and lowers the car between floors.

In hydraulic elevators, the weight of the car is supported by one or more hydraulic jacks. In order to raise the car, a motor pumps hydraulic fluid from a reservoir through a control valve into the jacks. To lower the car, the valve is opened to vent the jack, and the weight of the car causes fluid to flow out of the jack and back into the reservoir, and thereby allows the car to descend.

Traction elevators can be designed to operate over a broad range of speeds, depending upon the intended application, and can serve buildings ranging from two stories to skyscrapers. The principal drawbacks of traction elevators are their relatively high cost and the fact that they generally require an overhead penthouse, in order to house the pulleys and motor/drive system. Hydraulic elevators are less costly, but are not capable of operating as fast as traction elevators, and the number of floors that can be serviced is limited.

My prior U.S. Pat. No. 5,572,530 discloses an elevator system in which the car moves up and down using a traction drive instead of an overhead motor and pulley or a hydraulic cylinder. A pair of rollers, which are mounted on a swivel plate, are disposed on either side of a rail and pressed towards the rail to create friction. A motor, which is on the elevator car, drives at least one of the rollers to move the elevator car up or down. Such elevator has the advantages of a traction elevator, in terms of high speed capability and the potential to service high rise buildings, but does not require an overhead penthouse supporting a motor and drive system as in conventional traction elevators.

SUMMARY OF THE INVENTION

A traction drive elevator system preferably comprises a pair of vertical tracks, a car, and at least one counterweight for supporting at least a portion of the weight of the car. A traction drive, which preferably includes a frame which is separate from the car, comprises two sets of drives, each including a large traction roller and a pair of smaller diameter counter rollers which are disposed on opposite sides of one of the tracks. The axis of the traction roller is horizontal and parallel to the axes of the counter rollers. The traction roller is spaced vertically between, preferably at the vertical midpoint of, the counter rollers, and the counter rollers are moveable in a direction toward the track. Means, preferably an eccentric mounting in combination with a gas spring, urge the counter rollers towards the track, thereby creating friction between the rollers and the track. A motor and gear box, which preferably includes a worm and spur gear combination, selectively rotate the traction rollers for moving the car between landings. Finally, a safety bar maintains traction between the wheels and the track in the event the gas spring fails.

Preferably, the tracks constitute one of two inwardly projecting tracks of a rail which is U-shape in cross-section. The counter rollers are located in the U-shaped trough, and the traction roller is located to the outside of the rail and therefore can be made of substantially larger diameter. The other track is used to guide the counterweight.

For a better understanding of the invention, reference is made to the following detailed description of a preferred embodiment, taken in conjunction with the drawings accompanying the application. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of an elevator system according to the invention, with the near side wall of the elevator shaft omitted for clarity;

FIGS. **2** and **3** are front and top views, respectively, of the elevator system minus the elevator shaft;

FIG. **4** is a side view, taken in the direction of arrows **4**—**4** of FIG. **3**;

FIG. **5** is a front view of the motor and gearbox; and

FIGS. **6** and **7** are front and top views of an eccentric bias system used in the system.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** shows an elevator system including a car **10** moveable in a shaft **11** between a plurality of landings **12**, each landing having a conventional hatchway door **14**. A pair of vertical rails, one of which **16***a*, is visible in FIG. **1**, are supported by the pit floor, and are secured to the opposing shaft walls (the shaft wall on which rail **16***a* is mounted being omitted for clarity) using mounting brackets **18**. A pair of ropes, one of which **20** can be seen in FIG. **1**, each have one end connected to the car **10**, and extend around overhead pulleys **22** to a pair of counterweights **24** to support the weight of the car **10**. Finally, FIG. **1** shows one of two traction drives **26**, each of which includes a motor **28** and drive wheel **30**. The traction drives **26** are described in greater detail below.

Referring now to FIGS. **2**–**4**, each of the rails **16***a*, **16***b* is in the shape of an inwardly facing, U-shaped profile, so as to define a pair of parallel, inwardly directed tracks **36**, **37**. As shown in FIG. **4**, the U-shaped profile can be formed by connecting two right angle sections **32**, e.g., using brackets **34**. Alternatively, a single U-shaped rail can be used. Preferably the rails **16***a*, **16***b* are machined or cold pulled, in order that a conventional safety (not shown) can be used.

The traction drive **26** is preferably a self-contained unit, containing a frame **50** formed by various cross-members **52** and end plates **54**. In this manner, the traction drive **26** can be manufactured separate from the car **10**. The motor **28**, which is supported by the frame **50**, is coupled to a gear box **56**. A drive shaft **58** extends from the gear box **56** in either direction, through bearings **60** supported in each end plate **54**, and is coupled at either end to the traction wheels **30**.

Each traction drive **26** also includes two pairs of counter rollers **38**, **40**. Each counter roller **38**, **40** is rotatably mounted on a shaft **42** which is supported in eccentric mountings **44**, as described further below. A gas spring mechanism **46**, operating between the counter rollers **38**, **40** of each pair, causes the eccentrics to urge the counter rollers **38**, **40** toward the traction roller **30**.

The axes of the counter rollers **38, 40** are located above and below, respectively, the axis of rotation of the traction roller **30**. Preferably, the axis of the traction roller **30** is vertically midway between the two axes of the two counter rollers **38, 40**. In this manner, when the counter rollers **38, 40** are urged towards the track **36** (as described below), the rollers will press against the track **36** without creating torque about their horizontal axes.

The traction wheel **30** and the counter rollers **38, 40** of each pair are disposed on opposite sides of the track **36**, and the force of the gas spring **46**, pressing the traction **30** wheel towards the corresponding counter rollers **38, 40** causes the wheels **30, 38, 40** to bear against the track **36** and create friction between the traction wheel and the track **36**.

Referring to FIG. **4**, each drive roller **30** includes a metal hub **31** whose outer surface is covered by an annular ring **33** made of a plastic material such as polyurethane, which is bonded to the metal surface of the hub **31** for increasing the coefficient of friction of the surface of the roller **30** which is in contact with the track **36**. If desired, the mating surface of the track **36** may be roughened in order to increase its frictional value as well.

The two counterweight pulleys **22** are supported respectively at the top of the two rails **16***a*, **16***b*, such each counterweight rope **20** extends over one of the pulleys **22** and downwardly to its respective counterweight **24** (see FIGS. **3** and **4**). Each counterweight includes a guide **62** (see FIGS. **3** and **4**) which engages the other track **37** of the U-shaped rails **16***a*, **16***b*.

As shown in FIG. **5**, which shows the motor/drive assembly in greater detail, the motor **28** can be connected to an integral brake **70**, and a hand crank **72** can be provided for manually lowering or raising the car **10** in emergencies. The output shaft of the motor **28** is coupled to a gearbox shaft **76** on which is mounted a worm **80**. The worm **80** is geared to a worm wheel **82**, which is mounted on a common shaft **84** with a pinion gear **86** for rotation therewith. Preferably, the pinion gear **86** has a diameter which is smaller than the worm wheel **84**. The pinion gear, in turn, meshes with a spur gear **88** of substantially larger diameter, which drives the shaft **58** coupled to the traction wheels **30**. The combination of a worm and spur gear assembly allows the motor output shaft to be geared down to the desired speed for driving the traction rollers **30** in a very efficient and quiet manner.

FIGS. **6–7** show in greater detail the gas spring assembly **46**. A collar **90** is keyed to each of the shafts **42** on which the counter rollers **38, 40** are rotatably mounted, and includes a radially extending torque arm **92**. A gas spring **94** has its opposite ends connected by pins **96** to the opposed torque arms **92***a*, **92***b*. The gas spring thus urges the two torque arms apart with a predetermined force.

In addition to the gas spring, a safety bar **97** has one end **98** fixedly connected to torque arm **92***a*. The opposite end **99** extends through a hole **100** formed in torque arm **92***b*. The opposite end **99** includes threads **102**, and a pair of nuts **104**.

In operation, the gas spring **94** pushes the two torque arms **92***a*, **92***b* apart, which causes the shaft **42** to rotate in its eccentric mounting, thereby urging the wheels **38** and **40** towards the traction wheel **30**. The nuts **104** are adjusted so as to leave a slight clearance, e.g., about 5 mm, between the nuts **104** and the torque arm **92***b*. In this manner, during normal operation, the gas spring **94** will maintain a constant force between the wheels **38** and **40** and **30**, self-adjusting for wear. Should the gas spring fail, the torque arms **92***a*, **92***b* can move apart only slightly, because after initial movement the nuts **104** will engage the torque arm **92***b*, preventing the torque arms from moving further apart. The clearance between the nuts **104** and the torque arm **92***b* should be adjusted so that, if a gas spring **94** fails, the safety bar **97** will maintain sufficient traction between the rollers and the track to move the car **10** until repairs can be effected.

Because of the fact that, in the preferred embodiment, two counterweights are used, the rails and doors are centric within the shaft, thus allowing for a smaller shaft. Also, because of the fact that the U-shaped rails are very stiff and are supported on the pit floor, the walls do not have to withstand large forces.

The foregoing represent preferred embodiments of the invention. Variations and modifications of the processes and materials disclosed herein will be apparent to persons skilled in the art, without departing from the inventive concepts disclosed herein. For example, while a preferred embodiment has been described in which a U-shaped rail is used, so as to provide track surfaces for both the traction drive wheels and the counterweight guide, it would be possible to use separate rails for the counterweights, in which case other cross-sectional shapes of rails, such as T-shaped rails or hollow rails, may be employed for the traction drive. Also, while the counterweight rope is illustrated as being attached to the car, it may instead be connected to the traction drive. Further, less than two, more than two, or different arrangements of counterweight systems may be employed. And, while the invention has been described in which both counter rollers are eccentrically mounted so as to be moveable towards the track, only one of the counter rollers needs to be moveable, and means other than eccentrics can provide such movement. All such modifications and variations are within the scope of the invention, as defined in the following claims.

I claim:

1. An elevator system comprising:

at least two landings;

a first track extending in a vertical direction between said landings;

a car;

a counterweight means, including a rope and pulley, for supporting at least a portion of the weight of said car;

a traction drive comprising at least one traction roller and a pair of counter rollers, said traction roller and said counter rollers being disposed on opposite sides of said first track, each roller having a horizontal axis, wherein the axis of said traction roller is located at vertical height which is between the axes of the counter rollers, wherein at least one of said counter rollers is moveable in a horizontal direction toward said track; means for urging said counter rollers towards said track; and drive means for selectively rotating said traction roller for moving said car between landings; and

means for coupling said traction drive to said car.

2. An elevator system according to claim **1**, wherein the means for urging said counter rollers towards said track comprises a gas spring.

3. An elevator system according to claim **2**, wherein said at least one moveable counter roller is supported in eccentric means, and wherein said gas spring acts on said eccentric means for urging said counter roller towards said track.

4. An elevator system according to claim **3**, wherein said eccentric means includes at least one torque arm, wherein said gas spring is coupled to said torque arm.

5. An elevator system according to claim **4**, further comprising a safety bar coupled to said torque arm so as to permit only a predetermined amount of movement of said torque arm.

6. An elevator system according to claim 5, wherein the other of said counter rollers is supported in eccentric means so as to be moveable in a horizontal direction toward said track and includes a second torque arm, and wherein said gas spring is coupled between said torque arms, and wherein said safety bar has an end fixed to said second torque arm.

7. An elevator system according to claim 1, wherein said traction drive includes a traction drive frame which is separate from the car, and wherein said rollers and drive means are supported by the traction drive frame.

8. An elevator system according to claim 1, wherein said traction drive includes a motor, a worm gear coupled to said motor, a worm wheel engaging said worm gear, a pinion gear mounted on a common shaft with said worm wheel for rotation therewith, a spur gear engaging said pinion gear, and an output shaft coupled to said spur gear and to said traction wheel.

9. An elevator system according to claim 1, comprising a second track extending parallel to said first track, and wherein said traction drive comprises a second traction roller and a second pair of counter rollers, said second traction roller and said second pair of counter rollers being disposed on opposite sides of said second track, each roller having a horizontal axis, wherein the axis of said traction roller is located at a vertical height which is between the axes of the counter rollers of said second pair, and wherein at least one of the counter rollers of said second pair is moveable in a direction toward said track; means for urging the counter rollers of said second pair towards said track; and drive means for selectively rotating said second traction roller for moving said car between landings.

10. An elevator system according to claim 9, wherein said counterweight means includes a pair of pulleys supported respectively at an upper end of said first and second tracks, a pair of counterweights, and a pair of ropes, each rope being coupled to said car and extending over one of the pulleys to one of the counterweights.

11. An elevator system according to claim 9, comprising first and second rails disposed on opposite sides of said car, each rail having an inwardly facing, U-shaped cross-section defining a pair of parallel tracks, one track of said first rail forming said first track, and one track of said second rail forming said second track; and wherein each counterweight includes guide means for engaging one of the other tracks of said first and second rails.

* * * * *